CLAIMS

1. Cryogenic air separation apparatus for producing elevated pressure nitrogen comprising:

(A) a primary heat exchanger, a cryogenic air separation plant, and means for passing feed air to the primary heat exchanger and from the primary heat exchanger to the cryogenic air separation plant;

(B) a product compressor having a plurality of stages, a turboexpander, means for passing nitrogen from the cryogenic air separation plant to the primary heat exchanger and from the primary heat exchanger to the product compressor, and means for passing nitrogen from the product compressor to the primary heat exchanger and from the primary heat exchanger to the turboexpander;

(C) a booster compressor, means for passing nitrogen from the turboexpander to the primary heat exchanger and from the primary heat exchanger to the booster compressor, and means for passing nitrogen from the booster compressor to the product compressor; and

(D) means for recovering elevated pressure nitrogen from the product compressor.

2. The apparatus of claim 1 wherein the cryogenic air separation plant comprises a higher pressure column and a lower pressure column.

3. The apparatus of claim 2 wherein nitrogen from both the higher pressure column and the lower pressure column is passed to the product compressor.

4. The apparatus of claim 1 wherein the booster compressor is mechanically coupled to the turboexpander.

5. The apparatus of claim 2 further comprising a top condenser, means for passing fluid from the lower portion of the lower pressure column to the top condenser, and means for passing fluid from the top condenser to the primary heat exchanger.

6. The apparatus of claim 1 further comprising a subcooler, wherein the means for passing nitrogen from cryogenic air separation plant to the primary heat exchanger includes the subcooler.

7. The apparatus of claim 1 further comprising means for recovering liquid product from the cryogenic air separation plant.

8. The apparatus of claim 1 wherein the means for passing nitrogen from the product compressor to the primary heat exchanger draws nitrogen from an intermediate point of the product compressor.

9. The apparatus of claim 1 wherein the means for passing nitrogen from the product compressor to the primary heat exchanger comprises a first conduit having a valve and which communicates with the product compressor at a first position, and a second conduit having a valve and which communicates with the product compressor at a second position which is downstream of the first position.

10. The apparatus of claim 1 wherein the means for passing nitrogen from the booster compressor to the product compressor comprises conduit means for passing nitrogen to an upstream stage of the product compressor and conduit means for passing nitrogen to the product compressor downstream of said upstream stage of the product compressor.

11. A method for producing elevated pressure nitrogen comprising:

(A) cooling feed air in a primary heat exchanger, passing the cooled feed air into a cryogenic air separation plant, and producing nitrogen by cryogenic rectification within the cryogenic air separation plant;

(B) warming nitrogen withdrawn from the cryogenic air separation plant in the primary heat exchanger, compressing the warmed nitrogen in a product compressor, passing a portion of the compressed nitrogen as refrigerant nitrogen to the primary heat exchanger, cooling the refrigerant nitrogen, and turboexpanding the refrigerant nitrogen to generate refrigeration;

(C) warming the turboexpanded refrigerant nitrogen in the primary heat exchanger, compressing the turboexpanded refrigerant nitrogen in a booster compressor, and passing the resulting refrigerant nitrogen to the product compressor; and

(D) recovering elevated pressure nitrogen from the product compressor.

12. The method of claim 11 further comprising recovering liquid product from the cryogenic air separation plant.

13. The method of claim 11 wherein the warming of the turboexpanded refrigerant nitrogen in the primary heat exchanger serves to provide at least some of the cooling of the feed air.

14. The method of claim 11 wherein the refrigerant nitrogen is passed from the product compressor after less than the entire number of stages of the product compressor.

15. The method of claim 11 wherein the refrigerant nitrogen is passed from the product compressor after the entire number of stages of the product compressor.

16. The method of claim 11 carried out in two operating modes wherein in a first mode the refrigerant nitrogen passed to the primary heat exchanger has a pressure within the range of from 50 to 340 psia and the resulting refrigerant nitrogen passed to the product compressor has a pressure within the range of from 20 to 220 psia, and in a second mode the refrigerant nitrogen passed to the primary heat exchanger has a pressure within the range of from 90 to 700 psia and the resulting refrigerant nitrogen passed to the product compressor has a pressure within the range of from 50 to 390.

17. The method of claim 11 carried out in two operating modes wherein in a first mode the refrigerant nitrogen is passed to the primary heat exchanger from an upstream stage of the product compressor, and in a second mode the refrigerant nitrogen is passed to the primary heat exchanger from a stage downstream of said upstream stage.

18. The method of claim 11 carried out in two operating modes wherein in a first mode the resulting refrigerant nitrogen is passed to an upstream stage of the product compressor, and in a second mode the resulting refrigerant nitrogen is passed to a stage of the product compressor which is downstream of said upstream stage.

19. The method of claim 11 wherein the refrigerant nitrogen comprises from 3 to 25 percent of the compressed nitrogen.